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Evaluation of Commercial Buildings

for the Presence of

Polychloroaromatic Compounds

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EXECUTIVE SUMMARY

A site visit, inspection and field survey was performed by Daniel P. Boyd and Company (DPB) at the Endura Metals Manufacturing buildings located at 6900 Stanford Avenue, Los Angeles, California for the purpose of identifying potential chemical hazards that might present excess risk levels to future building users. Samples were collected to quantify the concentration of PCBs (polychlorinated biphenyls), PCDFs (polychlorinated dibenzofurans) and PCDDs (polychlorinated dibenzodioxins) in the air of the two separate buildings and on the floor and wall surfaces. This work was done as a continuation of an ongoing effort of site evaluation. Previous work had identified the presence of PCBs in bulk samples and sediments from the site. The current survey collected samples which provide useful data for estimation of potential human exposure to workers who may be employed at this site in the future. The site is currently unoccupied.

Site samples indicate that the airborne contamination found in the air of the buildings was at levels below the currently accepted concentrations of PCB's, PCDF's and PCDD's used in assessing the habitability of buildings in California and show no excess concentration above ambient background levels. No apparent excess risk would be presented to building users as a result of the measured amounts of PCBs, PCDFs and PCDDs detected during the week of this survey.

The survey findings indicate that there should be no restrictions on the use of this facility in relation to its potential chemical contamination. Survey measurements indicate that potential worker exposures to these chemicals would not result in any increase in risk levels above that considered as acceptable. These findings do not address the previously documented soil contamination levels, but due to the low probability of worker exposure to such soils, these are not anticipated to produce a sufficient increment of added exposure dose to invalidate the findings of the air and surface monitoring of this survey.

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1. INTRODUCTION

The survey site which was the object of this study included two separate brick buildings, previously used as a manufacturing facility by the Endura Metals Company. The building site is located in the Watts section of Los Angeles, California, in an area of light manufacturing and commercial services. No residential areas were in the immediate vicinity of the site. The entire site was surrounded by a security fence. The location had a rail siding along one edge of the property (East side) which was inactive. The two buildings are designated at the East (or Rear) Building and the West (or Front) Building.

At various times in the past there had been a variety of users of these buildings. At one time the site was reportedly used for the manufacture of military ~~ammunition~~. At another time the building was reported to have been used for the assembly of ~~electrical equipment~~. The last prior occupant of the building was a company engaged in the fabrication of metal parts and components. The complete history of use of the site is open to some speculation, and to our knowledge no complete record of its history exists.

*by who
for how
long*

Some prior survey work had been done in relation to the discovery of PCBs in the soil surrounding the buildings, on the rail siding right of way, and in the storm drain sediments located at ground level. There were also samples collected from some of the wood

beams of the building at spots where black soot deposits were visible on the underside of the roof. The presence of PCBs was verified for many of these samples. This early work was considered in the design of the current sampling effort to located possible areas or zones in which the presence of the PCBs might pose a risk to building occupants. A further issues addressed in this survey that had not been previously addressed was the question of whether any elevated levels of dioxins or furans were at the site to pose added risks from these toxic chemical exposures. The samples collected and reported in this report address these concerns.

previous
reports
1-1-10
analysis

2. SAMPLING AND ANALYSIS

The field survey was conducted over the six day period of March 3-8, 1986. The DPB field team was comprised of three persons, Dr. Daniel P. Boyd, Dr. Neil B. Jurinski, C.I.H. and Mr. David Woods, C.S.P. Copies of the resumes of these persons are included in Appendix F. Assisting with the field survey work were representatives from Bechtel National, Inc. (prime contractor) Mr. Kenneth E. Barr, Mr. Mark A. Golembiewski, C.I.H. and Mr. Peter A. Mote.

Air samples were collected by use of line operated sampling pumps for both the PCB samples and for the PCDD/PCDF samples. Airborne PCBs were collected on dual stage Florisil tubes in accordance with the procedure developed by the National Institutes for Occupational Safety and Health (NIOSH). Air flow rates were measured during the sampling period by use of a precision rotameter, calibrated against a primary standard bubble meter. Flow calibration data was collected throughout the sampling period for all air samples to obtain a time history of flow, since it is known that these flows can vary significantly over extended periods of time. Air volume for the samples were based upon the actual flow rates as recorded throughout the survey. Wipe samples were collected to allow evaluation of the surface concentrations of PCBs and of PCDD/PCDFs. The collection method used was that developed for monitoring the New York State

Binghamton Office Building. A detailed description of the sampling methods used for all sample types is given in Appendix B.

During the entire survey period one or more of these six field team members was present and supervising the sample collection. During the sampling an individual sample collection log was maintained for each of the dioxin sampling heads to record pump flow rates and meteorological conditions. Copies of these data are found in Appendix C. The configuration of the sampling train allowed simultaneous collection of the PCB samples at each of the pump stations used for the PCDD/PCDF samplers.

Each PCDD/PCDF sample was started by fabrication and assembly of the sampling head at Battelle Columbus Laboratories (BCL) in Ohio. This assembly included the cleaning and spiking of the silica absorbent as described in the BCL methods (Appendix D). An identical sampling head unit was supplied by BCL for pre-survey calibration of the pumps and sampling train. In the field each sampling head was assigned a field sample number using a date code to describe its initial use. A correlation table of all identification numbers for the samples is provided in Section 3 - Results. Upon completion of sampling each sample was sealed and kept under a chain of custody control for transmission to the appropriate laboratory. The analysis laboratory for the samples is also identified in Section 3.

The sampling for contaminants was conducted by monitoring the air and the building surfaces. Samples were collected for PCB, and for PCDD/PCDF determinations at various locations within and outside the building. The existing health standards for these materials require a different level of analytical sensitivity and a different analysis approach. Thus, it is not possible to determine all contaminants with accuracy from the same sample under the constraints of the current state of the art of analytical chemistry.

The more difficult analyses requiring extremely high sensitivity, and the ones with greater potential health implications, are the analyses for PCDD/PCDFs. Thus it was decided as a critical part of the sampling protocol to engage more than one analytical laboratory for this purpose. For the analysis of these samples, Battelle Columbus Laboratory, Ohio (Dr. Fred DeRoos) and Umea University, Sweden (Dr. Christoffer Rappe) were selected. The majority of analyses were performed by Dr. Rappe and the Quality Assurance analyses were performed by Dr. DeRoos. During pre-survey conversations with Dr. Bob Stephens of the California Department of Health Services, he expressed a desire to be provided with samples for confirmatory analysis in his laboratory. Therefore a total of three different chemical analysis laboratories were provided samples for PCDD/PCDFs. All PCB analyses were all conducted at fourth laboratory - Brown and

Caldwell Analytical Laboratories, Pasadena, California. The analytical methodology utilized by each of these laboratories for their contribution to the work is provided in Appendix D.

3. RESULTS

This section contains the results of the survey and analysis efforts. Table 3-1 arrays the sample identification number schemes used at various stages of this effort. In addition, the analytical laboratory that performed the analysis of each sample is identified. Table 3-2 shows the PCDD/PCDF air sampling data and the PCB air sampling data and results. Table 3-3 shows the PCB wipe sampling results reported in $\mu\text{g}/\text{M}^3$. Samples ranged from 6400 $\mu\text{g}/\text{M}^3$ to the detection limit of the sampling method.

$$* \left(\frac{1 \text{ m}^3}{1294.69} \right) = 4.94 \frac{\mu\text{g}}{\text{g}} = 4.94 \text{ ppm.}$$

Table 3-4 shows the PCDD/PCDF wipe sample results. Note that these samples have all been archived at the Battelle Columbus Laboratory for further analysis should that be required. Table 3-5 shows the results of the total tetra PCDD and PCDF congeners whereas Table 3-6 shows the results for the total tetra, penta, hexa, hepta and octa congeners. This table also relates the average indoor and outdoor values, as well as the excess indoor concentrations compared to the background (outdoor) value.

$$\begin{aligned} \text{Air Den.} &= \frac{10002}{1 \text{ m}^3} * \frac{2.3 \times 10^{-6}}{10} \\ &= 1294.69 \end{aligned}$$

TABLE 3-1

PCDD/PCDF Sampler Identification Numbers

BCL ID #	DPB Head #	NCC Field Sample #	Pump #	Analysis Lab*/#
41194-76-21	DPB-1	60303-1NJ	1	BCL/not provided
41194-76-22	DPB-2	60303-2NJ	2	UMEA/MPR 538:1
41194-76-23	DPB-3	60303-3NJ	3	UMEA/MPR 538:2
41194-76-24	DPB-4	60303-4NJ	4	BCL/not provided
41194-76-25	DPB-5	60303-5NJ	5	UMEA/MPR 538:3
41194-76-10	DPB-11	NCC Calibration Unit		Not Analyzed
41194-76-27	DPB-6	60306-2DB	3	C-DOH/not reported
41194-76-28	DPB-7	60306-3DB	1	C-DOH/not reported
41194-76-29	DPB-8	60305-1DB	2	UMEA/MPR 538:4
41194-76-30	DPB-9	60305-2DB	5	UMEA/MPR 538:5
41194-76-31	DPB-10	60306-1DB	4	UMEA/MPR 538:6

* BCL - Battelle Columbus Laboratories; Dr. DeRoos

UMEA - University of Umea, Sweden; Dr. Rappe

C-DOH - California Dept. of Health Services; Dr. Stevens

Table 3-2

PCDD/PCDF Air Sampling Data

NCC #	Rotometer Value	Flow Rate $\frac{\text{L}}{\text{min}}$	Sample Time	Air Volume
60303-1NJ	4.124	✓14.1 lpm	4255 min. ^{10.4.5}	60.00 M ³
60303-2NJ	6.289	✓23.8	2802	66.69
60303-3NJ	4.670	✗16.0	3868	62.27 61.89 M ³
60303-4NJ	5.060	✓17.6	3646	64.17
60303-5NJ	5.965	✓21.3	2964	63.13
60305-1DB	5.396	✓19.0	3205	60.90
60305-2DB	4.950	✓17.2	3614	62.16
60306-1DB	5.785	✓20.6	3281	67.59
60306-2DB	6.412	✓24.6	3126	76.90
60306-3DB	5.894	✓21.2	2829	59.97

PCB Air Sampling Data

NCC Field Sample #	Sample Time	Sample Volume	Sample Location	PCB* (ug/M ³) Concentration
60303-6NJ	1483 min	1269. liter	East building, Pump 3	< ND **
60303-7NJ	1483	1482.	East building, Pump 3	< ND **
60303-8NJ	1468	1396.	East building, Pump 4	< ND **
60303-9NJ	1468	1566.	East building, Pump 4	< ND **
60303-10NJ	0	0	Field Blank	< ND **
60303-11NJ	1320	1307.	West building, Pump 1	< ND **
60303-12NJ	1320	1267.	West building, Pump 1	< ND **
60303-13NJ	1433	1419.	West building, Pump 2	< ND **
60303-14NJ	1433	1462.	West building, Pump 2	< ND **
60303-15NJ	1427	1456.	Outdoor air, Pump 5	< ND **
60303-16NJ	1427	1313.	Outdoor air, Pump 5	< ND **

* Aroclor 1260

** ND - None Detected at Minimum Detection Limit of 0.15 ug/M³ or laboratory analysis limit of 0.2 ug.

Table 3-4

PCDD/PCDF Wipe Sampling Results

NCC Field Sample #	Sample Type	Surface Concentration	Sample Location
60306-19NJ	Floor	AR *	East building/N-end
60306-20NJ	Floor	AR *	East building/N-center
60306-21NJ	Floor	AR *	East building/Center
60306-22NJ	Floor	AR *	East building/E-center
60306-23NJ	Floor	AR *	East building/W-center
60306-24NJ	Floor	AR *	East building/S-center
60306-25NJ	Floor	AR *	East building/S-end
60306-26NJ	Floor	AR *	West building/N-end
60306-27NJ	Floor	AR *	West building/N-center
60306-28NJ	Floor	AR *	West building/E-center
60306-29NJ	Floor	AR *	West building/W-center
60306-30NJ	Floor	AR *	West building/S-end
60306-31NJ	Wall	AR *	East building/N-end of east wall
60306-32NJ	Wall	AR *	East building/N-side of east doors
60306-33NJ	Wall	AR *	East building/S-side of east doors
60306-34NJ	Wall	AR *	West building/N-wall east of door
60306-35NJ	Wall	AR *	West building/N-center section, North of windows
60306-36NJ	Field Blank	AR *	Field Blank

* AR - Archive Sample, retained in storage at Battelle
Columbus Laboratory.

Table 3-5
PCDD/PCDF
Air Sample Analytical Results

→ Detection
Limit

NCC Field Sample #	Lab	Sample Location	Concentration (pg/M ³)	
			TCDD	TCDF
60303-1NJ	BCL	West building/Pump 1 Southwest quad/West wall	ND	ND
60303-2NJ	UMEA	West building/Pump 2 Northwest quad	ND	3.0
60303-3NJ	UMEA	East building/Pump 3 South center	ND	3.6
60303-4NJ	BCL	East building/Pump 4 Northeast quad	ND	2.8
60303-5NJ	UMEA	East building/Pump 5 Northeast corner/Outdoor air	ND	2.4
60305-1DB	UMEA	West building/Pump 2 Northwest quad	ND	2.3
60305-2DB	UMEA	East building/Northeast corner/Pump 5/Outdoor air	ND	2.6
60306-1DB	UMEA	East building/Pump 4/ Northwest quad	ND	3.6
60306-2DB	C-DOH	East building/Pump 3/ South center wall	NA	NA
60306-3DB	C-DOH	West building/Pump 1/ Southwest quad	NA	NA
ARITHMETIC AVERAGE:			(2 BUILDINGS)	ND 3.1
			(2 OUTDOOR AIR)	ND 2.5

ND - None detected above minimum detection limit
NA - Not available as of 9/30/86

Table 3-6

Analytical Results, Total PCDD/PCDF Congeners (pg/M³)

UMEA Results	Tetra- D F		Penta- D F		Hexa- D F		Hepta- D F		Octa- D F	
<u>Indoor:</u>										
60303-2NJ	ND	3.0	ND	4.2	0.77	1.2	1.4	0.76	0.44	0.16
60303-3NJ	ND	3.6	ND	4.1	0.65	1.2	1.1	0.59	0.60	0.17
60305-1DB	ND	2.3	ND	2.7	0.42	0.59	0.47	0.33	0.33	0.10
60306-1DB	ND	3.6	ND	3.3	0.28	1.4	1.8	1.4	1.2	0.25
Average:	ND	3.1	ND	3.6	0.53	1.1	1.2	0.77	0.64	0.17
<u>Outdoor:</u>										
60303-5NJ	ND	2.4	ND	2.6	0.83	0.70	1.3	0.62	0.83	0.17
60305-2DB	ND	2.6	ND	1.6	0.55	0.35	1.5	0.43	2.3	0.23
Average:	ND	2.5	ND	2.1	0.69	0.53	1.4	0.53	1.6	0.20
<u>Excess</u>										
Indoor:	ND	0.6	ND	1.5	-0.16	0.57	-0.20	0.24	-0.96	-0.03
<u>Duplicates:</u>										
60303-2NJ	ND	3.0	ND	4.2	0.77	1.2	1.4	0.76	0.44	0.16
60305-1DB	ND	2.3	ND	2.7	0.42	0.59	0.47	0.33	0.33	0.10

ND - None detected above minimum detection limit

4. DISCUSSION OF OBSERVATIONS

The analysis results obtained by the various laboratories define the observed air and surface concentrations of PCBs and the air concentrations of PCDD/PCDFs (Tables 3-2, 3-3, 3-5 and 3-6). The analysis of surface samples for PCDD/PCDFs was deferred, and the samples archived at BCL until the air analysis results were obtained. The present results are sufficiently low that DPB sees no need for these samples to be analyzed. As seen from the tabulated data (Table 3-6), no analytically significant measurable elevation above ambient air concentrations was found.

The PCB air samples indicate that at all sites monitored the airborne concentrations were below 0.15 ug/M^3 . This represents the detection limit of the laboratory conducting this analysis work. This concentration is approximately 10-fold lower than the NIOSH recommended limit of 1.0 ug/M^3 and approximately 500-fold lower than the California Occupational Safety and Health Administration (CALOSHA) limit of 500 ug/M^3 .

Neither NIOSH nor CALOSHA have established limits for surface contamination by PCBs. The San Francisco transformer fire incident led to a cleaning guideline of 100 ug/M^2 (equal to 1 ug/100 cm^2). However, in that situation PCBs were being used as a surrogate compound to imply the associated presence of PCDD/PCDF pyrolysis products, a situation which is not a valid

approach at the Watts site. The measured amounts of PCBs on surfaces was observed to range from the laboratory detection limit ($<200 \text{ ug/M}^2$) on all wall samples, up to 6400 ug/M^2 on the floor (Table 3-3). The floors of the West Building had average levels of PCBs that were lower than those in the East Building. This is an indication that at some former time some PCBs had been released, and that there are higher residue levels in the East Building.

Evaluation of the PCDD/PCDFs in the air samples produced no observable levels of dioxin congeners above that found in the ambient outdoor air. No tetra- or penta- chlorinated dioxin were found in the samples. The airborne concentrations of PCDFs given in the Table 3-6 show that a variety of congeners of PCDFs are present.

The analysis data report only the different amounts of the individual chemical groups, but do not give any relationship to their toxic risk potential. A method has been developed to deal with this question of the varying toxicity of the chemical homologues. This technique was first developed by New York State Department of Health. The process involves relating the chemical concentrations of materials with uncertain toxicity (because of a paucity of data from animal testing) to the toxicity of 2,3,7,8-TCDD, the method of "2,3,7,8-TCDD Equivalents". This latter compound is chosen because it is the most studied compound of the

entire series of PCDD/PCDF isomers. A detailed discussion of this approach is given in Section 5 below.

5. APPLICABILITY OF STANDARDS

Current concern over the presence of PCDD/PCDFs at locations in which PCBs have been found to be present must be kept in the proper context. Recent events involving electrical equipment fires or explosions have indicated that under those unusual conditions some significant levels of either or both of these compounds may be formed. The amount of each type of compound, and its isomer distribution, has also been found to vary depending upon the nature of the fire or explosion and the type of PCB fluid present in the equipment. PCDDs have been found only when chlorinated benzenes were present in the transformer fluid. There have been numerous investigations of PCBs for their PCDD/PCDF contents under other situations classified as "normal use", and these have routinely indicated relatively insignificant amounts of these higher aromatics are present. This is apparently due to the slow formation of these compounds during the use cycle. There have been relatively few investigations conducted to determine with reliability what are the "typical" ambient concentrations of PCDD/PCDFs found in the environment, and in particular to the expected levels in a zone used for manufacturing operations. It should be noted that PCDD/PCDFs are ubiquitous environmental contaminants arising from multiple sources including waste incineration, chlorinated phenols, herbicides and automobile exhaust.

In 1983 the California Department of Health Services has had experience with a PCB transformer fire which contaminated a building located in downtown San Francisco. This event caused a high level of concern for the associated health impact on building occupants from the presumed presence of elevated levels of PCDD/PCDFs resulting from PCB pyrolysis. However, upon further investigation there were no PCDDs found at this site, which is consistent with the absence of chlorinated benzenes in transformer fluids used at this site. The application of similar concerns to the 6900 Stanford Street site is inappropriate, since there is no indication that any accidental event has occurred at the site which would have produced pyrolysis reactions of PCBs or chlorinated benzenes. Lacking such a highly energetic event as a fire or explosion, it is improbable that any significant amounts of PCDD/PCDFs could form spontaneously from any PCBs or chlorinated benzenes which may have been in use at this site by former owners or occupants. The findings observed from the sample analysis of this current survey fall within the zone of levels deemed to be representative of background levels of these compounds in an industrial zone. The standards applied during the San Francisco PCB transformer fire were recommended by the DOHS risk assessment group to be control levels applied above background concentrations. Unfortunately, at that time no work was completed to define the background concentrations of these compounds.

The use of polychlorinated biphenyls (PCBs) as a dielectric fluid in electrical equipment has in recent years been recognized as a potential problem if there exists any possibility for its uncontrolled combustion. These fluids have been used either by themselves, or in mixtures with viscosity modifying chlorinated benzenes, as a non-flammable alternative to mineral oil in liquid cooled electrical transformers and in electrical capacitors. This fluid has found widespread use in locations where fire hazards of mineral oil made that liquid an unsuitable choice. The PCB fluids have been sold under various tradenames, but Monsanto's commercial name of Aroclor is most commonly recognized. There exist various commercial grades of Aroclor (e.g. Aroclor 1242 or Aroclor 1254). For the Aroclors the last two digits of the grade usually represent the chlorine weight percentage of the mixture. For example, Aroclor 1254 contains 54% chlorine, by weight.

PCB fluids are a mixture of chlorinated biphenyl compounds with different degrees and positions of chlorination. Thus, one commercial product, e.g. Aroclor 1254 contains many separate PCB congeners. A major problem of PCB fluid combustion, such as occurs during low temperature incineration or electrical equipment fires, is the formation of pyrolysis compounds that have different toxic effects than the PCBs from which they originated. Formation of polychlorinated dibenzofurans (PCDFs), polychlorinated dibenzodioxins (PCDDs) and polychlorinated

biphenylenes (PCBPs) have all been experimentally observed as possible pyrolysis products associated with incomplete combustion of PCB fluids containing chlorinated benzenes. These compounds have been determined to be highly toxic materials, and great efforts have been made to assure that human exposure to these substances is maintained at minimal levels.

As a result of some electrical equipment failures (either explosions or fires) several cases have been studied to provide guidance on the requirements for decontamination of structures following a PCB fire which releases PCDD/PCDFs and related compounds into a building. The current state of knowledge of toxic properties of all of these compounds is so incomplete that decisions based upon a detailed analysis of what chemicals are present is not feasible. Instead, the approach has been to attempt to relate the presumed toxicity of related compounds (which have not been thoroughly evaluated for toxicity) to a single compound 2,3,7,8-tetrachlorodibenzodioxin (otherwise known as 2378-TCDD). This relational approach attempts to assign a toxicity equivalence factor (TEF) for the other structurally similar compounds. The TEF provides an assumed measure of the relative toxicity of a compound, or class of compound, to the toxicity of 2378-TCDD.

Appendix A contains some of the variety of approaches (A-D) to this determination of "2378-TCDD equivalents" which have been

suggested by various health related groups or regulatory advisory agencies. In reviewing this information it should be remembered that different toxicity endpoints may have been used, as well as different assumptions concerning the duration of subsequent exposure of persons reentering the affected building structures. A further basis of difference is the choice of the level of "acceptable risk" which is not a scientific or technical, but a societal, decision.